

CLAIMS

1. An image forming apparatus comprising:
 - a latent image carrier that is rotatable and configured to carry a latent image;
 - 5 a cleaning blade that cleans toner remaining on a cleaning area on the latent image carrier; and
 - a lubricant applying element that is arranged on downstream side of the cleaning blade with respect to direction of rotation of the latent image carrier, and that
- 10 applies a lubricant to a lubricant applying area on the latent image carrier, wherein the cleaning area and the lubricant applying area overlap.
2. The image forming apparatus according to claim 1,
 - 15 wherein the cleaning area and the lubricant applying area are substantially same area on the latent image carrier.
3. The image forming apparatus according to claim 1,
 - 20 wherein the lubricant applying element is a brush roller and the lubricant is a bar-shaped lubricant, and
 - the image forming apparatus includes a mechanism that rotates the brush roller so that the brush roller scrapes off the bar-shaped lubricant and applies scrapped lubricant to the latent image carrier.
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4. The image forming apparatus according to claim 3,
 - further comprising a smoothing blade, wherein
 - the cleaning blade is provided on an upstream side in the direction of rotation of the latent image carrier, and
 - 30 the smoothing blade is provided on the downstream side, and
 - widths of the brush roller and the smoothing blade with the latent image carrier in its longitudinal direction have a relation

width of brush roller ≤ width of smoothing blade.

5. The image forming apparatus according to claim 4,
wherein

5 widths of the brush roller and the cleaning blade with
the latent image carrier in its longitudinal direction have
a relation

width of brush roller ≤ width of cleaning blade.

10 6. The image forming apparatus according to claim 3,
wherein

widths of the bar-shaped lubricant and the brush
roller with the latent image carrier in its longitudinal
direction have a relation

15 width of lubricant ≤ width of brush roller.

7. The image forming apparatus according to claim 1,
wherein

20 widths of a charged portion and a lubricant applied on
the latent image carrier in its longitudinal direction have
a relation:

charge width ≤ width of lubricant applied.

25 8. The image forming apparatus according to claim 1,
wherein the latent image carrier has a frictional
coefficient of 0.4 or less.

30 9. The image forming apparatus according to claim 1,
wherein the cleaning blade includes a side seal for
preventing toner scattering, and the lubricant applying
area can be adjusted based on position of the side seal.

10. The image forming apparatus according to claim 1,
wherein the toner is such that a shape factor SF-1
indicating a degree of sphericity of a toner shape is in a
range from 100 to 180, and that a shape factor SF-2
5 indicating a degree of irregularities of the toner shape is
in a range from 100 to 180.

11. The image forming apparatus according to claim 1,
wherein the toner is such that a volume-average particle
10 size (D_v) is in a range from 3 to 8 micrometers, and a
degree of dispersion defined by a ratio (D_v/D_n) between the
volume-average particle size (D_v) and a number-average
particle size (D_n) is in a range from 1.00 to 1.40.

15 12. The image forming apparatus according to claim 1,
wherein the toner is such that a ratio (r₂/r₁) between a
minor axis and a major axis of the toner is in a range from
0.5 to 1.0, a ratio (r₃/r₂) between its thickness and the
minor axis is in a range from 0.7 to 1.0, and a relation of
20 major axis r₁ ≥ minor axis r₂ ≥ thickness r₃ is satisfied.

13. The image forming apparatus according to claim 1,
wherein the toner is obtained by allowing a toner material
solution to undergo either one of or both of crosslinking
25 reaction and elongation reaction in an aqueous medium, the
toner material solution being obtained by dissolving or
dispersing at least a polymer having a portion enabling
reaction with a compound that contains an active hydrogen
group, and a release agent in an organic solvent.

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14. The image forming apparatus according to claim 1,
further comprising:
a process cartridge that integrally supports the

latent image carrier and at least one selected from a lubricant applying device which applies the lubricant to the latent image carrier, a charging device, a developing device, and a cleaning device, and that is detachably mounted.

5 15. An image forming apparatus comprising:
a cleaning blade that removes toner remaining on a surface of an image carrier after a toner image is transferred;

10 a lubricant applying device including
a lubricant; and
a noncontact lubricant-applying element that applies a component of the lubricant to the image carrier
15 in a noncontact manner; and

a lubricant smoothing blade that spreads the lubricant applied to the image carrier, to form a thin layer, wherein torque of the image carrier which is contacted only by the cleaning blade is higher than torque of the image carrier,
20 with the lubricant applied, which is contacted by the cleaning blade and the lubricant smoothing blade.

25 16. The image forming apparatus according to claim 15, wherein the lubricant smoothing blade is set in a trailing manner.

30 17. The image forming apparatus according to claim 15, wherein toner to be used is such that a volume-average particle size is 10 micrometers or less, and a ratio, being a degree of dispersion, between the volume-average particle size and a number-average particle size is in a range from 1.00 to 1.40.

18. The image forming apparatus according to claim 15,
wherein toner to be used has an average circularity of 0.93
to 1.00.

5 19. The image forming apparatus according to claim 15,
wherein toner to be used is such that a shape factor SF-1
indicating a degree of sphericity of a toner shape is in a
range from 100 to 180, and that a shape factor SF-2
indicating a degree of irregularities of the toner shape is
10 in a range from 100 to 180.

20. The image forming apparatus according to claim 15,
wherein toner to be used is such that its external shape is
almost spherical, and a ratio (r_2/r_1) between a minor axis
15 and a major axis of the toner is in a range from 0.5 to 1.0,
a ratio (r_3/r_2) between its thickness and the minor axis is
in a range from 0.7 to 1.0, and a relation of major axis r_1
 \geq minor axis $r_2 \geq$ thickness r_3 is satisfied.

20 21. The image forming apparatus according to claim 15,
wherein the toner is obtained by allowing a toner
composition to undergo either one of or both of
crosslinking reaction and elongation reaction in an aqueous
medium in the presence of resin fine particles, the toner
25 composition including at least a polyester prepolymer
having a functional group that contains nitrogen atoms, a
polyester, a colorant, and a release agent.

22. An image forming apparatus comprising:
30 a cleaning blade that removes toner remaining on a
surface of a image carrier after a toner image is
transferred;
a lubricant applying device including

a lubricant; and
a contact lubricant-applying element that
contacts the lubricant to be adhered thereto, and applies a
component of the lubricant to the image carrier in a
5 contact manner; and

a lubricant smoothing blade that spreads the lubricant
applied to the image carrier, to form a thin layer, wherein
torque of the image carrier which is contacted only by the
cleaning blade is higher than torque of the image carrier,
10 with the lubricant applied, which is contacted by the
cleaning blade, the lubricant smoothing blade, and the
contact lubricant-applying element.

23. The image forming apparatus according to claim 22,
15 wherein the lubricant smoothing blade is set in a trailing
manner.

24. The image forming apparatus according to claim 22,
wherein the contact lubricant-applying element is an
20 applying roller that is made to rotate, and the applying
roller is driven at a speed equal to or higher than a speed
of the surface of a photoconductor.

25. The image forming apparatus according to claim 22,
wherein toner to be used is such that a volume-average
25 particle size is 10 micrometers or less, and a ratio, being
a degree of dispersion, between the volume-average particle
size and a number-average particle size is in a range from
1.00 to 1.40.

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26. The image forming apparatus according to claim 22,
wherein toner to be used has an average circularity of 0.93
to 1.00.

27. The image forming apparatus according to claim 22, wherein toner to be used is such that a shape factor SF-1 indicating a degree of sphericity of a toner shape is in a range from 100 to 180, and that a shape factor SF-2 indicating a degree of irregularities of the toner shape is in a range from 100 to 180.

28. The image forming apparatus according to claim 22, wherein toner to be used is such that its external shape is almost spherical, and a ratio (r_2/r_1) between a minor axis and a major axis of the toner is in a range from 0.5 to 1.0, a ratio (r_3/r_2) between its thickness and the minor axis is in a range from 0.7 to 1.0, and a relation of major axis $r_1 \geq$ minor axis $r_2 \geq$ thickness r_3 is satisfied.

29. The image forming apparatus according to claim 22, wherein the toner is obtained by allowing a toner composition to undergo either one of or both of crosslinking reaction and elongation reaction in an aqueous medium in the presence of resin fine particles, the toner composition including at least a polyester prepolymer having a functional group that contains nitrogen atoms, a polyester, a colorant, and a release agent.

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30. An image forming apparatus comprising:
an image carrier on which a toner image is formed;
a cleaning blade that cleans the image carrier after the toner image is transferred to a transfer material;
30 a blade holder that holds the cleaning blade; and
a lubricant applying device that applies a lubricant to the image carrier, wherein
the lubricant applying device includes

a solid lubricant,
a lubricant applying element,
a guide that guides the solid lubricant so that
the solid lubricant can move substantially only in a
5 direction of approaching or separating from the lubricant
applying element, and
a pressing unit that presses the solid lubricant
against the lubricant applying element, wherein
positions of the pressing unit and the cleaning blade
10 are respectively set so that a direction in which the
pressing unit presses the solid lubricant against the
lubricant applying element and a direction in which the
cleaning blade is protruded toward the surface of the image
carrier are almost parallel to each other, and
15 the blade holder is fixed to the guide directly or
through another element.

31. The image forming apparatus according to claim 30,
wherein positions of the image carrier, the lubricant
20 applying element, and the pressing unit are respectively
set so that a line connecting between a rotation center of
the image carrier and a rotation center of the lubricant
applying element and the direction in which the pressing
unit presses the solid lubricant are on almost the same
25 line.

32. The image forming apparatus according to claim 30,
further comprising a lubricant smoothing unit that smoothes
the lubricant applied to the image carrier, wherein the
30 lubricant applying element is arranged on downstream side
of the cleaning blade in a movement direction of the
surface of the image carrier.

33. The image forming apparatus according to claim 30,
wherein the lubricant smoothing unit includes a smoothing
blade that contacts the image carrier, and the smoothing
blade is set in a trailing direction with respect to the
5 movement direction of the surface of the image carrier.

34. The image forming apparatus according to claim 30,
wherein toner to be used is such that a volume-average
particle size is 10 micrometers or less, and a ratio, being
10 a degree of dispersion, between the volume-average particle
size and a number-average particle size is in a range from
1.00 to 1.40.

35. The image forming apparatus according to claim 30,
15 wherein toner to be used has an average circularity of 0.93
to 1.00.

36. The image forming apparatus according to claim 30,
wherein toner to be used is such that a shape factor SF-1
20 indicating a degree of sphericity of a toner shape is in a
range from 100 to 180, and that a shape factor SF-2
indicating a degree of irregularities of the toner shape is
in a range from 100 to 180.

25 37. The image forming apparatus according to claim 30,
wherein toner to be used is such that its external shape is
almost spherical, and a ratio (r_2/r_1) between a minor axis
and a major axis of the toner is in a range from 0.5 to 1.0,
a ratio (r_3/r_2) between its thickness and the minor axis is
30 in a range from 0.7 to 1.0, and a relation of major axis r_1
 \geq minor axis $r_2 \geq$ thickness r_3 is satisfied.

38. The image forming apparatus according to claim 30,

wherein the toner is obtained by allowing a toner composition to undergo either one of or both of crosslinking reaction and elongation reaction in an aqueous medium in the presence of resin fine particles, the toner 5 composition including at least a polyester prepolymer having a functional group that contains nitrogen atoms, a polyester, a colorant, and a release agent.

39. A lubricant applying device comprising:

10 a lubricant that is accommodated in the lubricant applying device;

an applying roller that applies the lubricant to an image carrier, being an applied surface; and

15 a smoothing element that spreads the lubricant applied to the image carrier to form a thin layer, wherein the lubricant is applied after adherents on the applied surface are cleaned, and the lubricant applied is further smoothed.

20 40. The lubricant applying device according to claim 39, wherein the smoothing element is detachably provided in the lubricant applying device.

25 41. The lubricant applying device according to claim 39, wherein the lubricant is detachably provided in the lubricant applying device.

42. The lubricant applying device according to claim 39, wherein the image carrier is a photoconductor.

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43. The lubricant applying device according to claim 39, wherein the image carrier is a transfer element.

44. The lubricant applying device according to claim 39, wherein the applying roller is a fiber brush, and the smoothing element is made of an elastomer having a blade shape.

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45. The lubricant applying device according to claim 39, wherein the applying roller is formed with a plurality of films.

10 46. The lubricant applying device according to claim 39, wherein the smoothing element contacts the applied surface in a trailing manner.

15 47. The lubricant applying device according to claim 39, wherein the lubricant is a powdery type.

48. A lubricant applying device comprising:

a solid lubricant that is accommodated in the lubricant applying device;

20 an applying roller that contacts the solid lubricant to be adhered to the surface thereof with lubricant as a component of the solid lubricant, and applies the lubricant to an image carrier;

25 a pressing element that presses the solid lubricant against the applying roller so that the solid lubricant contacts the applying roller; and

a smoothing element that spreads the lubricant applied to the image carrier to form a thin layer, wherein

30 the solid lubricant is disposed in the lower side with respect to the applying roller in the direction of gravity,

the pressing element is disposed in the lower side with respect to the solid lubricant in the direction of gravity,

the lubricant is applied after adherents on the applied surface are cleaned, and
the lubricant applied is further smoothed.

5 49. A lubricant applying device comprising:
a solid lubricant that is accommodated in the
lubricant applying device;
an applying roller that contacts the solid lubricant
to be adhered to the surface thereof with lubricant as a
10 component of the solid lubricant, and applies the lubricant
to an image carrier;
a pressing element that presses the solid lubricant
against the applying roller so that the solid lubricant
contacts the applying roller; and
15 a smoothing element that spreads the lubricant applied
to the image carrier to form a thin layer, wherein
the solid lubricant moves in a direction perpendicular
to a direction of rotation of the applying roller.

20 50. A lubricant applying device comprising:
a solid lubricant that is accommodated in the
lubricant applying device;
an applying roller that contacts the solid lubricant
to be adhered to the surface thereof with lubricant as a
25 component of the solid lubricant, and applies the lubricant
to an image carrier;
a pressing element that presses the solid lubricant
against the applying roller so that the solid lubricant
contacts the applying roller; and
30 a smoothing element that spreads the lubricant applied
to the image carrier to form a thin layer, wherein
the applying roller moves in a direction perpendicular
to a direction of rotation of the applying roller.

51. A lubricant applying device comprising:

a lubricant that is accommodated in the lubricant applying device;

5 an applying roller that applies the lubricant to an image carrier; and

a smoothing element of which edge portion formed with a sheet-like elastic body is pressed against the surface of the image carrier in its trailing posture, to press and 10 spread the lubricant applied thereto, wherein

a contact angle of the smoothing element with respect to the image carrier is 10 degrees or more.

52. A lubricant applying device comprising:

15 a lubricant that is accommodated in the lubricant applying device;

an applying roller that applies the lubricant to an image carrier;

20 a smoothing element of which edge portion formed with a sheet-like elastic body is pressed against the surface of the image carrier in its trailing posture, to press and spread the lubricant applied thereto; and

25 a cleaning element of which edge portion formed with a sheet-like elastic body is pressed against the surface of the image carrier in its counter posture, to remove a foreign matter from the surface thereof, wherein

the cleaning element, the applying roller, and the smoothing element are arranged in this order from an upstream side in a direction of movement of the image 30 carrier, and

a contact angle of the smoothing element with respect to the image carrier is 10 degrees or more.

53. A lubricant applying device comprising:

a lubricant that is accommodated in the lubricant applying device;

5 an applying roller that applies the lubricant to an image carrier;

a smoothing element of which edge portion formed with a sheet-like elastic body is pressed against the surface of the image carrier in its trailing posture, to press and spread the lubricant applied thereto; and

10 a cleaning element of which edge portion formed with a sheet-like elastic body is pressed against the surface of the image carrier in its counter posture, to remove a foreign matter from the surface thereof, wherein

15 the cleaning element, the applying roller, and the smoothing element are arranged in this order from an upstream side in a direction of movement of the image carrier, and

a contact linear pressure of the smoothing element is 0.01 N/cm or more.

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54. A transfer device comprising:

a transfer element that is an image carrier; and

the lubricant applying device according to claim 39 that is detachably provided in the transfer device.

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55. A process cartridge comprising:

an image carrier on which a latent image is formed; and

30 a process unit that includes at least one selected from

a charging device that uniformly charges the surface of the image carrier,

a developing device that supplies toner to the

latent image and visualizes the latent image,

a cleaning device that cleans the surface of the image carrier, and

5 a lubricant applying device that applies lubricant to an applied surface, wherein

the process cartridge integrally supports the image carrier and the process unit, and is detachable from an image forming apparatus, and

10 the lubricant applying device is the lubricant applying device according to claim 39.

56. An image forming apparatus comprising:

an image carrier on which a latent image is formed;

15 a charging device that uniformly charges the surface of the image carrier;

an exposing device that exposes the surface of the image carrier charged, with light to write a latent image thereon based on image data;

20 a developing device that supplies toner to the latent image and visualizes the latent image;

a cleaning device that cleans the surface of the image carrier;

25 a transfer device that transfers an image visualized as a toner image on the surface of the image carrier directly to a recording medium or to the recording medium after the image is transferred to an intermediate transfer element;

a fixing device that fixes the toner image on the recording medium; and

30 the lubricant applying device according to claim 39.

57. The image forming apparatus according to claim 56, wherein the image carrier is a photoconductor and is a so-

called tandem type such that a plurality of photoconductors are aligned in a tandem manner.

58. The image forming apparatus according to claim 56,
5 wherein the lubricant applying device is disposed on the downstream side of the cleaning device in a direction of movement of the image carrier.

59. The image forming apparatus according to claim 56,
10 wherein a lubricant used in the lubricant applying device is a powdery type, and a volume-average particle size is in a range from 0.1 millimeters to 3.0 millimeters.

60. The image forming apparatus according to claim 56,
15 wherein

the lubricant is fatty acid metal salt, and metal of the fatty acid metal salt is selected from zinc, iron, calcium, aluminum, lithium, magnesium, strontium, barium, cerium, titan, zirconium, lead, and manganese, and

20 a fatty acid of the fatty acid metal salt is at least one fatty acid selected from lauryl acid, stearic acid, palmitic acid, myristic acid, and oleic acid.

61. The image forming apparatus according to claim 56,
25 wherein a frictional coefficient of the image carrier is set to 0.3 or less.

62. The image forming apparatus according to claim 56,
wherein toner to be used is such that a volume-average
30 particle size is 10 micrometers or less, and a ratio, being a degree of dispersion, between the volume-average particle size and a number-average particle size is in a range from 1.00 to 1.40.

63. The image forming apparatus according to claim 56, wherein toner to be used has an average circularity of 0.93 to 1.00.

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64. The image forming apparatus according to claim 56, wherein toner to be used is such that a shape factor SF-1 indicating a degree of sphericity of a toner shape is in a range from 100 to 180, and that a shape factor SF-2 10 indicating a degree of irregularities of the toner shape is in a range from 100 to 180.

65. The image forming apparatus according to claim 56, wherein toner to be used is such that its external shape is almost spherical, and a ratio (r_2/r_1) between a minor axis and a major axis of the toner is in a range from 0.5 to 1.0, a ratio (r_3/r_2) between its thickness and the minor axis is in a range from 0.7 to 1.0, and a relation of major axis $r_1 \geq$ minor axis $r_2 \geq$ thickness r_3 is satisfied.

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66. The image forming apparatus according to claim 56, wherein toner to be used is obtained by allowing a toner composition to undergo either one of or both of crosslinking reaction and elongation reaction in an aqueous medium in the presence of resin fine particles, the toner composition including at least a polyester prepolymer having a functional group that contains nitrogen atoms, a polyester, a colorant, and a release agent.

30 67. A toner in which a volume-average particle size is 10 micrometers or less, and a ratio, being a degree of dispersion, between the volume-average particle size and a number-average particle size is in a range from 1.00 to

1.40.

68. The toner according to claim 67, wherein an average circularity of the toner is in a range from 0.93 to 1.00.

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69. The toner according to claim 67, wherein a shape factor SF-1 indicating a degree of sphericity of a toner shape is in a range from 100 to 180, and a shape factor SF-2 indicating a degree of irregularities of the toner shape 10 is in a range from 100 to 180.

70. The toner according to claim 67, wherein an external shape of the toner is almost spherical, and a ratio (r_2/r_1) between a minor axis and a major axis of the toner is in a 15 range from 0.5 to 1.0, a ratio (r_3/r_2) between its thickness and the minor axis is in a range from 0.7 to 1.0, and a relation of major axis $r_1 \geq$ minor axis $r_2 \geq$ thickness r_3 is satisfied.

20 71. The toner according to claim 67, which is obtained by allowing a toner composition to undergo either one of or both of crosslinking reaction and elongation reaction in an aqueous medium in the presence of resin fine particles, the toner composition including at least a polyester prepolymer 25 having a functional group that contains nitrogen atoms, a polyester, a colorant, and a release agent.